Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Real-time measurement of quasiparticle tunneling in a single-junction transmon qubit using feedback[1] DIEGO RISTÈ, NIELS BULTINK, MARIJN TIGGELMAN, RAYMOND SCHOUTEN, Kavli Institute of Nanoscience, Delft University of Technology, KONRAD LEHNERT, JILA, NIST and the University of Colorado, Boulder, LEONARDO DICARLO, Kavli Institute of Nanoscience, Delft University of Technology — With coherence times of superconducting qubits now exceeding 100 μs, the contribution of quasiparticle (QP) tunneling to qubit relaxation and dephasing becomes potentially relevant. We report the real-time measurement of QP tunneling across the single junction of a 3D transmon qubit. We integrate recent developments in projective qubit readout with 99% fidelity and feedback-based reset to transform the qubit into a charge-parity detector with 6 μs resolution. We detect a symmetric random telegraph signal matching a QP tunneling time of 0.8 ms. By measuring the correlation function of charge parity conditioned on specific initial and final qubit states, we determine that most QP tunneling does not induce qubit transitions, in contradiction with recent theory [1]. We extract a QP-induced qubit relaxation time $T_1^{\mathrm{qp}} \sim 3$ ms, decidedly not limiting the measured $T_1 = 0.14$ ms.

[1] G. Catelani et al., Phys. Rev. B 84, 064517 (2011).

[1]Research supported by NWO, FOM, and EU Project SOLID.

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Date submitted: 09 Nov 2012 Electronic form version 1.4